

# EDUCATOR GUIDE

# MISSION FUTURE:

# ARIZONA 2045

This guide introduces concepts and activities for educators to use with their students centered around *MISSION FUTURE: Arizona 2045* at Arizona Science Center. This guide contains activities that are aligned to state standards and are organized by grade band.



Never stop wondering.  
Never stop imagining.™

# EXHIBITS OVERVIEW AND CONCEPTS

## INTRODUCTORY VIDEO

As you enter the exhibition, make sure to view the introductory video to meet all five characters. Each character presents a possible version of the future and the challenges that each version faces.

**Concepts:** *Human Impact on the Environment, Sustainability*

## RANCH HOUSE

Isabela and Lucas recently became co-owners of their family's ranch. View the video to learn the siblings' differing perspectives about its future. Help Isabela and Lucas decide what to do with their land as Arizona faces extreme heat, drought and other effects of climate change.

**Concepts:** *Climate Change, Space Exploration, Technology*

## ISABELA'S DESK

Learn more information about Isabela's plan for the ranch by exploring the conservation-related tools on her desk. The artifacts on Isabela's desk establish that she cares about the history, nature and culture of the ranch land.

**Concepts:** *Technology, Sustainability, Human Impact on the Environment*

## HEAT AND LAND USE INTERACTIVE

Learn about conditions in 2020 and think about how people today might choose to respond to climate change. View Isabela and Lucas' notes, and notice that they have been examining historical data about land use to understand changes to the natural and built environment in central Arizona.

**Concepts:** *Analyze and Interpret Data, Earth's Climate*

## PLAN A COMMUNITY

Help Isabela and Lucas create a plan for the ranch. Using the magnetic wall and tiles, look at the siblings' ideas and help them create a plan for the future.

**Concepts:** *Technology, Climate Change, Developing and Using Models*

## LUCAS' DESK

Browse Lucas' desk, which has a variety of sustainable building materials. These artifacts establish his interest in technologies that can present solutions to climate impacts and enable more sustainable ways of living.

**Concepts:** *Technology, Sustainability, Human Impact on the Environment*

## ISABELA AND LUCAS' SOCIAL MEDIA

Learn more about this version of the future! Gain insight into Isabela and Lucas' lives via their social media feed, which reveals more about what the climate may be like in Arizona in 2045.

**Concepts:** *Technology, Sustainability, Earth's Climate, Climate Change*

## AR SANDBOX

Use the Topobox to understand how water availability may be affected by changes in climate, including the physical form (i.e. mountains, valleys, plains, deserts, etc.) and use of land (i.e. farming, industrialization, etc.).

**Concepts:** *Landforms, Water Availability, Climate Change, Developing and Using Models*



## AVA AND ZOE VIDEO

Twins Ava and Zoe must decide what STEM career they want to pursue, and whether they want to live on Earth or in space. They make choices and take actions that reflect their values and ways of thinking about the future. Ava and Zoe prioritize different factors when they think about their future careers.

**Concepts:** Career Connection, Technology

## AVA'S DESK

Ava works in a research and development lab on Earth, where she is building small drones that are designed to collect data in different atmospheres. The artifacts on Ava's desk show what she is working on.

**Concepts:** Technology, Human Impact on the Environment

## AVA AND ZOE'S SOCIAL MEDIA

There are many career opportunities in fields related to Earth and space science, including NASA and commercial partners (now and in the future). Ava and Zoe's social media feeds reveal more about these different career options.

**Concepts:** Technology, Career Connection

## DRONE PROTOTYPING

The lab is developing drones that can carry scientific instruments in two simulated non-Earth atmospheres. Help Ava by building small drones, testing them in special wind tubes, and improving your design so that they can fall gently or hover in the air stream.

**Concepts:** Engineering Design Process, Developing and Using Models, Technology, Lift, Drag, Wind

## SPACE STATION SIMULATION

Zoe lives and works on a space station, which is a challenging environment. For humans to survive in the harsh environment of low Earth orbit, space stations must provide essentials like power, oxygen and water. Guests will operate a game that models the systems of a space station, and the forces and energy that affect its operation.

**Concepts:** *Technology, Space, Energy, Forces, Career Connection, Solar System, The Sun*

## PERSONAL SPACECRAFT INTERACTIVE

Watch a display of video clips to learn more about NASA science discoveries and missions.

**Concepts:** *Earth and Space Science, The Sun, Earth, Planets, Solar Energy*

## FUTURE THINKER QUIZ

People think about the future differently, and this diversity of views is important. ALLI is studying different types of future thinkers and needs more data. Take a quiz and learn what kind of future thinker you are, according to ALLI.

**Concepts:** *Sustainability, Human Impact on the Environment, Artificial Intelligence, Technology*

## FUTURE PERSPECTIVE INTERACTIVE

Share your opinion on Arizona's future by putting a token in the slot at this station. As someone who thinks about the future and participates in shaping the future, your thoughts are very important!

**Concepts:** *Human Impact on the Environment, Sustainability*



# ESSENTIAL QUESTIONS

These three questions provide the framework for guiding learning through *MISSION FUTURE*:

1. What are some effects of climate change that Arizona will experience in the future?
2. What are some possible ideas of what Arizona might be like in the year 2045?
3. Why is it important to consider all viewpoints of how we should respond to the changes that Arizona will face in the future?

## EDUCATOR RESOURCES ALIGNED TO EXHIBIT STANDARDS



[GREENHOUSE EFFECT IN A JAR](#)



[RENEWABLE RESOURCES](#)



[THE SUN'S ENERGY](#)



[ENERGY SOURCES](#)



[RENEWABLE/  
NONRENEWABLE](#)



[HUMAN IMPACT](#)



[ENERGY FLOW](#)



[PHOTOSYNTHESIS  
ACTIVITY](#)



[IMPACT OF  
CATTLE GRAZING  
ON PLANTS  
ARTICLE](#)



[COLORADO  
RIVER  
MANAGEMENT  
INTERACTIVE  
MAP](#)



[PLANTING TREES  
TO MITIGATE  
CLIMATE CHANGE](#)



[HOW PLANTS  
IMPACT GLOBAL  
WARMING](#)



[ARIZONA STATE  
CLIMATE OFFICE](#)



[CITY OF  
PHOENIX'S COOL  
URBAN SPACES](#)



[URBAN HEAT  
ISLANDS](#)



[CLIMATEKIDS  
NASA](#)



[CITIZEN  
SCIENCE NASA](#)

# EXHIBIT STANDARDS BY GRADE LEVEL

## 2018 ARIZONA SCIENCE STANDARDS

### GRADE 3

**3.E1U1.4** Construct an explanation describing how the Sun is the primary source of energy impacting Earth systems.

**3.P4U1.3** Develop and use models to describe how light and sound waves transfer energy.

### GRADE 4

**4.E1U1.6** Plan and carry out an investigation to explore and explain the interactions between Earth's major systems and the impact on Earth's surface materials and processes.

### GRADE 6

**6.E1U1.6** Investigate and construct an explanation demonstrating that radiation from the Sun provides energy and is absorbed to warm the Earth's surface and atmosphere.

### GRADE 7

**7.L2U1.12** Construct an explanation for how some plant cells convert light energy into food energy.

### GRADE 8

**8.E1U3.8** Construct and support an argument about how human consumption of limited resources impacts the biosphere.

**POST-VISIT ACTIVITY**

**DESIGNING  
THE FUTURE**

**GRADES 3-5**

# DESIGNING THE FUTURE

## OVERVIEW

Before energy from the Sun reaches the geosphere (Earth's rocks and sediments), it first must pass through Earth's atmosphere (all of the gasses that surround Earth). Radiation from the Sun heats the Earth's surface. All Earth processes are the result of energy flowing and matter cycling within and among Earth's systems. Some of this energy is reflected back to space by clouds, some is absorbed by the atmosphere, but most of it is absorbed by the geosphere. This energy provides a source of heat that helps Earth regulate its temperature, making it an ideal and habitable place for living things in the biosphere (all the living things on Earth). But not all places on Earth absorb energy the same way! Materials on Earth that are dark, rough and dry absorb more of the Sun's energy, whereas materials that are light, smooth, and moist or wet reflect more of the Sun's energy. In this lesson, students will engage in an investigation in order to explain how the Sun's energy is absorbed and reflected differently depending on the properties of various Earth materials in the geosphere and biosphere. They will use this information to evaluate climate change trends for Phoenix and possible solutions.

## BACKGROUND

Earth's energy originates from the Sun and Earth's interior. Earth's major systems are the geosphere (solid and molten rock, soil, and sediments), the hydrosphere (water and ice), the atmosphere (air), and the biosphere (living things, including humans). These systems interact in multiple ways to affect Earth's surface materials and processes. Light also transfers energy from place to place. For example, energy radiated from the sun is transferred to Earth by light. When this light is absorbed, it warms Earth's land, air and water, and facilitates plant growth. Human activities affect Earth's systems and their interactions at its surface. Scientists record the patterns of the weather across different times and areas so that they can make predictions about what kind of weather might happen next. Climate describes the ranges of an area's typical weather conditions and the extent to which those conditions vary over years to centuries.

## MATERIALS

- [Phoenix Satellite Map](#)
- [Booming Growth in Phoenix Suburbs interactive](#)
- [Phoenix Time-Lapse video](#)
- [State Climate Summary for Arizona website](#)
- Scissors
- Pencil
- Access to large, outdoor spaces on school grounds (including asphalt courts, grassy fields or concrete sidewalks)
- Timers (1 per student group)
- Thermometers (1 per student group)
- Colored pencils or crayons (1 set per student group)
- [Soakin' Up the Sun's Energy!](#) handout (1 per student)
- [Cool Pavement Program website](#)
- [The Roof Is Growing!](#) website
- [What is a Cool Roof?](#) article
- [Urban Heat Island](#) article



# DESIGNING THE FUTURE

## ARIZONA STANDARDS

**3.E1U1.4** Construct an explanation describing how the Sun is the primary source of energy impacting Earth systems.

**4.E1U1.6** Plan and carry out an investigation to explore and explain the interactions between Earth's major systems and the impact on Earth's surface materials and processes.

## 5E LEARNING CYCLE

### ENGAGE

After returning from Arizona Science Center, ask students to recall information from *MISSION FUTURE* through a discussion.

- What predictions does *MISSION FUTURE* have for Arizona in 2045? What problems might we be facing (climate, drought)?
- Isabela and Lucas are trying to plan for the future of their Arizona farm. What were some of the things they were planning for?

*Students should recall that climate change is really affecting the future, and Isabela and Lucas are dealing with its effects on their farm. They are trying to plan for ways to deal with drought and extreme temperature increases.*

As we saw in *MISSION FUTURE*, what we are doing today can have a huge impact on the future. Isabela and Lucas have been looking at the “past” (our present) to understand how land use resulted in the problems they are facing in their present day.

If we look at information we have today, can we “see” where some of the contributions to climate change are occurring now? Could we start to make changes now to alter the future that Isabela and Lucas would face? Let's do some exploring to see what we can find out!

### EXPLORE

Display the [Phoenix Satellite Map](#) to students and inform them that this is a satellite image of Phoenix and the surrounding cities. Give students a moment to look at the map and then discuss what they notice. Point out what the different items on the map are (land, farms, homes, streets).

# DESIGNING THE FUTURE

## EXPLORE

Open the [Booming Growth in Phoenix Suburbs interactive](#) and toggle between the two images. Again, ask students to discuss what they notice about the maps of the same area from 1989 and 2009. They should take note that farmland has diminished, there are major highways and roads, a lot of buildings, and less open desert present.

Finally, play the [Phoenix Time-Lapse video](#). Inform students that the red color represents plants and vegetation. What do they notice? How has the amount of vegetation changed over the years?

In looking at all of these maps, we are able to see that Phoenix has grown in population a lot, and with that growth has come a lot of buildings and roads, which have impacted the amount of natural space. Now, let's look at some more information on the changes Phoenix has been experiencing with temperatures.

Visit the [State Climate Summary for Arizona](#) website, and walk students through the graphs and information found there. What do they notice about temperatures in Arizona? Rainfall? Is it getting hotter? Why might this be happening?

It looks like temperatures are increasing in the Phoenix area—something we know Isabela and Lucas were concerned about. Is there a connection between the amount of building and growth Phoenix has experienced to the rising temperatures and drought levels?

Previously, students have learned about Earth's four systems and how the Sun's energy (in the form of light and heat) can impact all of Earth's systems. Without the Sun's energy, none of the systems would be able to function and support life on Earth!

It looks like some of the systems are experiencing changes based on droughts and increased temperature. Let's investigate how the Sun's energy can impact Earth's systems, and think about how that might relate to the changing temperatures, water availability and urban development in Phoenix.

Let's say we had to walk across the various surfaces at school barefoot! You could choose between walking on asphalt like the blacktop court, walking on concrete like sidewalks, or walking on a grassy field. In order to keep your feet from getting hot, which surface would you rather walk on barefoot? Why?

- Prompt students to share their ideas aloud with the class.

# DESIGNING THE FUTURE

## EXPLORE

Many students will say that they would choose to walk barefoot on the grassy field because it's cooler than the other surfaces. But, all of these surfaces are part of Earth's geosphere and biosphere systems. If all these surfaces are a part of Earth's systems, why would they have different temperatures?

- Prompt students to share their ideas aloud with the class. Possible student responses may include: They all look different from one another; They feel different; They are made up of different things.

If all these surfaces are a part of Earth's systems, why would they have different temperatures? Let's take some time to explore this more.

1. Divide students into groups of five to form investigation teams.
2. Distribute the *Soakin' Up the Sun's Energy!* handout to each student and one timer, one thermometer and one set of colored pencils/crayons to each investigation team.
3. Review the investigation instructions with students by reading aloud the directions on the *Soakin' Up the Sun's Energy!* Handout.
4. Guide students to the outdoor spaces on school grounds, including the asphalt, sidewalk and grassy field. Prompt student groups to begin their investigations, starting with the asphalt, moving to the sidewalk and ending with the grassy field.
5. Closely monitor and assist student groups during this exploration.

**Teacher Tips:** *Ensure that all students are following the safety instructions, as outlined on the *Soakin' Up the Sun's Energy!* Handout.*

6. After seven minutes, prompt student groups to grab their materials and move to the next investigation location.
7. Once all groups have completed the investigation at each location and recorded their findings, guide students back to the classroom.
8. Before engaging students in a whole-class discussion of their findings, prompt investigation groups to discuss and record responses to the following questions in their science journals:
  - Review your investigation data. Which surface was the hottest? Which surface was somewhere in the middle? Which surface was the coolest? How do you know?
  - Review your observations. How were the surfaces similar to each other? How were they different from each other?

# DESIGNING THE FUTURE

## EXPLAIN

Once all groups have discussed and recorded responses to the follow-up questions, facilitate a class discussion of significant findings. During this time, encourage listening students to contribute to the thoughts of others by asking questions and sharing their ideas.

- Based on your data, which surface was the hottest? How do you know?
- Which surface was in the middle? How do you know?
- Which surface was the coolest? How do you know?
- Looking back at your observations, how were the surfaces similar to each other? How were they different from each other?
  - Prompt students to share their responses aloud with the class.
  - Possible student responses may include: The asphalt and concrete were both hard; The concrete and grassy field were both smooth and soft; The asphalt was hard and rough; The grassy field was a little wet; The asphalt was dark; The concrete was light; The grassy field had both light and dark pieces with the sand and the grass.
- Looking at your observations and data, what can you conclude or say, using reasoning, about the properties of materials and their temperatures?
  - Prompt students to share their responses aloud with the class.
  - Possible student responses may include: Lighter in color materials are less hot; Materials that are darker in color are hotter; Surfaces that are rough are hotter than surfaces that are smooth; Surfaces that are wet are cooler than surfaces that are dry.

As the Sun's energy hits Earth, some materials absorb or take in more energy than others, based on their properties. For example, materials that are dark in color, rough and dry absorb more energy than other materials. This is why these materials and their surroundings are warm, like the asphalt! In addition to some materials absorbing the Sun's energy, some materials reflect or bounce back the Sun's energy, based on their properties. For example, materials that are light in color, smooth and wet reflect more energy than other materials. This is why these materials and their surroundings are cooler, like the grassy field. There are materials that are somewhat in the middle. For example, the concrete is light in color, but it is also rough and dry. Therefore, its temperature is in between the asphalt and the grassy field.

At this point, we have discussed our findings from our investigations. Let's return to our discussion from earlier: Is there a correlation between the rising temperatures and drought to the growth of the City of Phoenix? **Teacher Tip:** At this point, students should be connecting that with the addition of black asphalt roads, many houses, less farmland and less natural desert spaces humans are impacting the climate.

# DESIGNING THE FUTURE

## EXTEND

Now that we have evaluated what is happening in Phoenix , we can see that the future could look like Isabela and Lucas' present, where they are struggling with drought and high temperatures on their farm. Currently, there are many scientists trying to find ways to change the trends of climate to make the future better—let's look at some of these now.

Provide students with the following resources:

- [Cool Pavement Project](#) website
- [The Roof Is Growing!](#) website
- [What is a Cool Roof?](#) article
- [Why are Green Spaces Important?](#) article
- [Urban Heat Island](#) article

As students read and explore these resources, pause to have discussions about each one. Ask students to connect the solution from the resource with a way that it can help Phoenix.

## EVALUATE

Have students respond to the following prompt in writing:<sup>4</sup>

- What is one solution you would want to implement in Phoenix to help with climate change? What problem does this solution address? How would it change things for Isabela and Lucas in the future?

# DESIGNING THE FUTURE

## DIFFERENTIATION SUGGESTIONS

1. Watch the [MISSION FUTURE video](#) and look through pictures in the [image gallery](#) to help students recall information from the exhibition to make connections.
2. Show students pictures of each of the three surfaces to reference during the discussion: Blacktop court, sidewalk and grassy field. Ask students to think about their past experiences walking on each of these surfaces. Were they all the same temperature? Did any of these surfaces burn your feet while walking barefoot?
3. Provide students with a graphic organizer, table or sentence stems to use when answering the follow-up questions. Depending on the needs of the students, students may also be given the option to explain their understanding orally to their classmates and/or educator. Allow students to complete the activity independently, with a partner, or as a small group.
4. Allow students to choose how to show their understanding. Options may include: give an oral presentation, create a slideshow presentation, make a poster, record themselves answering the questions verbally or complete provided sentence stems.

**POST-VISIT ACTIVITY**

**NEED TO  
BREATHE**

**GRADES 6-8**

# NEED TO BREATHE

## OVERVIEW

Earth's atmosphere is a transparent layer of gases that allows sunlight to pass through, reaching and warming Earth's surface. The radiation from the Sun absorbed by the Earth warms the surface which then emits radiation of longer wavelengths (infrared) that do not pass through the atmosphere but are absorbed by it, keeping the Earth warm. This is called the greenhouse effect because it is similar to the way the inside of a greenhouse is heated by the Sun. Greenhouse gases in the atmosphere absorb and retain the energy radiated from land and ocean surfaces, thereby regulating Earth's average surface temperature and keeping it habitable for life on Earth. Climate change is a multidisciplinary issue, concerning the world's scientists, politicians, humanitarian organizations and global citizens alike. In this investigation, students will learn about the effects that climate change is having on our local community and how carbon plays a role in this. They will then explore different ways to lessen the amount of carbon in the atmosphere, including the role plants play through photosynthesis.

*This lesson should be taught post-visit, and serves as a review of the standards after they have already been introduced in other lessons. This lesson builds upon prior knowledge of solar energy heating Earth, and ways that it may be trapped causing excessive temperatures as well as knowledge of photosynthesis and plant structures.*

## BACKGROUND

Plants, algae (including phytoplankton) and many microorganisms use the energy from light to make sugars (food) from carbon dioxide in the atmosphere and water through the process of photosynthesis, which also releases oxygen. These sugars can be used immediately or stored for growth or later use.

Human activity, which controls the growth of certain plants and animals, changes an ecosystem. Ecosystems are dynamic in nature, and their characteristics can vary over time. Disruptions to any physical or biological component of an ecosystem can lead to shifts in all of its populations. Human activities have significantly altered the biosphere, sometimes damaging or destroying natural habitats, and causing extinction of many other species. But changes to Earth's environment can have different impacts (negative and positive) for different living things.

## MATERIALS

- Science journals (1 per student)
- Pen or pencil (1 per student)
- [Arizona Agricultural Lands](#) interactive map
- [Colorado River Reservoirs](#) interactive map
- [Colorado River](#) article
- [Climate Change](#) activity
- [Climate Change Phenomena](#) e-magazine
- [Carbon Unbalanced](#) handout
- [Carbon Unbalanced](#) answer key
- [Plant Drawing](#)
- [How Many Trees Needed to Offset Carbon Emissions?](#) article
- [Carbon Calculator](#)
- Clear bowl or cup with water
- Fresh leaf



# NEED TO BREATHE

## ARIZONA STANDARDS

**7.L2U1.12** Construct an explanation for how some plant cells convert light energy into food energy.

**6.L2U1.13** Develop and use models to demonstrate the interdependence of organisms and their environment including biotic and abiotic factors.

**6.E1U1.6** Investigate and construct an explanation demonstrating that radiation from the Sun provides energy and is absorbed to warm the Earth's surface and atmosphere.

**6.L2U3.11** Use evidence to construct an argument regarding the impact of human activities on the environment and how they positively and negatively affect the competition for energy and resources in ecosystems.

**8.E1U3.8** Construct and support an argument about how human consumption of limited resources impacts the biosphere.

## 5E LEARNING CYCLE ENGAGE

Introduce the topic of today's lesson through a discussion with students.

- Ask if they are able to list the 5 C's of Arizona and write this list on the board.
- Are there any similarities between these items? **Teacher Tip:** Lead students to realize that Cattle, Citrus and Cotton are all part of a farm.
- Do you recall the issues that Isabela and Lucas were facing on their Arizona farm? They were worried about climate change, increased heat and drought affecting their farm. They may have even produced one of the 5 C's on their land, and want to find a way to continue to do so.

A farm is a type of ecosystem that humans have a big impact on. An ecosystem is a community or group of living organisms that live in and interact with each other in a specific environment. Allow students to share their thoughts on the following questions:

- What makes a healthy ecosystem?
- What are some ways that an ecosystem can become unbalanced, or unhealthy?
- Can an unhealthy ecosystem be repaired?

Examine the issues facing Arizona farms and look at some possible solutions to the issues they face.

# NEED TO BREATHE

## EXPLORE

Display the map of [Arizona Agricultural Lands](#). Inform students that the green areas are the current location of farming or agricultural land in Arizona. Have students examine the map and ask them what they notice about the location of the farms. **Teacher Tip:** *Students should come to the realization that the majority of the farm lands are located near a river or source of water.*

Are the rivers of Arizona in a healthy state? Can they continue to support agriculture? Have students explore the interactive map of the [Colorado River Reservoirs](#) to determine that the levels are low. Showing pictures of the river levels can also exemplify this. Discuss their observations as a class.

What do you think has caused these levels to lower? Many connect climate change to this situation. Let's read to find out more and decide if you agree.

1. Provide students with the article explaining the drought in the [Colorado River](#). After providing time for them to read, lead a class discussion.
  - According to the article, what is causing the lower water levels?
  - How does that connect to temperature and climate? Have temperatures really changed?
    - Have students use the interactive [Climate Change activity](#) to see how much change has occurred in areas they are familiar with.
2. Now that students are starting to uncover how increased temperatures and climate change are affecting the water sources for Arizona, ask them how this might pose a problem to our farmers. **Teacher Tip:** *Refer back to the Agricultural Land Map if needed. Farmers rely on water sources to grow their plants, and they will not be able to continue if the supply runs out.*
3. What is causing all of this change to happen? Have students visit the interactive e-magazine [Climate Change Phenomena](#) (make sure they also click on the links inside the magazine to gain more insight) in partners. After they have explored the information provided, ask students to summarize what the main "factor" is that has the ability to affect our climate so drastically and is creating imbalances within our ecosystems. **Teacher Tip:** *Students should come to the conclusion that human impact on the carbon cycle is the factor that is currently creating the imbalances.*
4. In partners, provide students with the [Carbon Unbalanced](#) worksheet and direct students to use the e-magazine to fill in the sheet to see where the "carbon" is ending up. They will be able to compare human-impact versus the natural cycle to observe that human-impact is placing carbon in the atmosphere and leaving things imbalanced, versus the natural cycle that moves carbon throughout all the "spheres".

# NEED TO BREATHE

## EXPLORE

5. As a class, discuss observations about the cycle.
  - Where is most of the carbon ending up?
  - What happens when a greenhouse gas, such as carbon, is in the atmosphere?
  - How could this be contributing to the rising temperatures and climate change issues Arizona faces with river water levels?
  - In looking at the movement of carbon, are there any instances where the carbon is moving out of the atmosphere? **Teacher Tip:** *Students should note that plants take carbon from the atmosphere to the biosphere.*
6. How are plants able to do this? Lead students in a discussion about plants and photosynthesis using the talking points below. **Teacher Tip:** *This should be a review of concepts.*
7. Display the simple plant drawing for students. Ask them to name the various things necessary for this plant to live and thrive (prompt students to think back to earlier lessons). **Teacher Tip:** *Students should name sunlight, water (rain), soil, and maybe air or carbon dioxide.*

These are all the necessary elements that need to be present in order to help plants survive. However, what is the process that plants do to take these elements and turn them into food energy? If you recall, in order to create energy, plants undergo a process called photosynthesis. As many of you already know, plants need to have sunlight in order to survive. In addition to sunlight, plants also need water and carbon dioxide. Plant cells contain a vital organelle called chloroplasts. These chloroplasts are responsible for making food for the plant and contain a special molecule called chlorophyll which causes the green coloring in the plant.

As previously stated, plants have organelles called chloroplasts which are the organelles that are responsible for making food for plants. We all know that plants need sunlight and water, but they also need carbon dioxide from air. These chloroplasts help the plants absorb all of these materials and convert them into energy. What part of the plant do you think plays the biggest role in absorbing the sunlight and carbon dioxide?

The leaves on the plants are very green and large, helping to absorb the sunlight and the carbon dioxide from the air. As many of us observed, plants have leaves, and on these leaves are small openings that absorb the carbon dioxide.

# NEED TO BREATHE

## EXPLORE

8. Take a leaf and submerge it in water. Have students observe the leaf after a few minutes.
- What do they see?
  - What are the tiny bubbles?
  - Where do they come from?
  - Have students share their thoughts.

The last part of photosynthesis is another very important part that helps us as humans out quite a bit! Once the plant has created its food, the plant then releases oxygen. Plants release oxygen because it is considered the “waste” from the photosynthesis cycle, just like animals release waste within their food cycle! As many of us know, oxygen is what we need to breathe and survive! Those bubbles are oxygen that the plant is releasing.

## EXPLAIN

Now that students have had the opportunity to explore the issues facing Arizona and its farmers, and how plants play a role in the carbon cycle, help them make connections from the model to the issue of climate change by discussing the following questions:

- What role do plants play in the carbon cycle?
- How might plants help mitigate the amount of carbon in the air?
- What might reducing carbon do for our ecosystems?
- How can carbon reduction in ecosystems help Arizona farmers?

Have students read the article [How Many Trees Needed to Offset Carbon Emissions?](#) and do the [carbon calculator](#).

## EXTEND

Students can explore other ways that people are trying to offset the carbon emissions to help with climate change. Have students research a way that they would want to try and then describe whether that approach would be something that Isabela or Lucas would want to try.<sup>2</sup>

# NEED TO BREATHE

## EVALUATE

After students complete their investigations, provide the following prompt to write in their science journals: It seems like there are a lot of ways climate change is impacting Arizona. Based on your investigations and class discussions, what is a major contributor to climate change? How is it affecting Arizona? How might plants help? Would plants be a solution that is more in line with what Isabela would want to do or Lucas (think back to the exhibit and what they said their interests were)?<sub>3</sub>

# NEED TO BREATHE

## DIFFERENTIATION SUGGESTIONS

1. For additional support, display pictures of each of the 5 C's on the board for students to reference.
2. Provide students with specific websites or materials that they can use to research possible solutions. Video resources are always a plus for students who prefer visual learning.
3. Allow students to choose how to show their understanding. Options may include: Give an oral presentation, create a slideshow presentation, make a poster, record themselves answering the questions verbally or complete provided sentence stems.

# BOOK YOUR FIELD TRIP TODAY!

If you have a group of 15 or more,  
you are eligible for group discounts!  
To schedule your field trip or group visit, head to  
**AzScience.Org.**



Never stop wondering.  
Never stop imagining.™